SYLVANIA

# engineering data service 5977

## MECHANICAL DATA

| | |
|---|---|
| Bulb | T-3 |
| Base | E8-10, Subminiature Button Flexible Leads |
| Outline | JETEC 3-1 |
| Basing | 8DK |
| Cathode | Coated Unipotential |
| Mounting Position | Any |

### RATINGS[1] (Absolute Maximum)

| | |
|---|---|
| Impact Acceleration | 450 G |
| Uniform Acceleration | 1000 G |
| Fatigue (Vibrational Acceleration for Extended Periods) | 2.5 G |
| Bulb Temperature | 220° C |
| Altitude[2] | 80000 Ft. |

## ELECTRICAL DATA

### HEATER CHARACTERISTICS

| | Min. | Bogey | Max. |
|---|---|---|---|
| Heater Voltage[3] | 6.0 | 6.3 | 6.6 V |
| Heater Current | | 150 | mA |

### DIRECT INTERELECTRODE CAPACITANCES

| | Shielded[4] | Unshielded |
|---|---|---|
| Grid to Plate | 1.3 | 1.3 μμf |
| Input | 2.0 | 2.0 μμf |
| Output | 2.2 | 0.8 μμf |

### RATINGS[1 & 5] (Absolute Maximum)

| | |
|---|---|
| Plate Voltage | 180 Vdc |
| Peak Plate Forward Voltage[6] | 360 v |
| Plate Dissipation | 3.3 W |
| Plate Current | 22 mAdc |
| Grid Current | 4.4 mAdc |
| DC Grid Voltage | |
| Positive Value | 0 Vdc |
| Negative Value | 55 Vdc |
| Heater-Cathode Voltage | |
| Heater Positive with Respect to Cathode | 200 v |
| Heater Negative with Respect to Cathode | 200 v |
| Grid Circuit Resistance | 1.1 Meg |

### CHARACTERISTICS

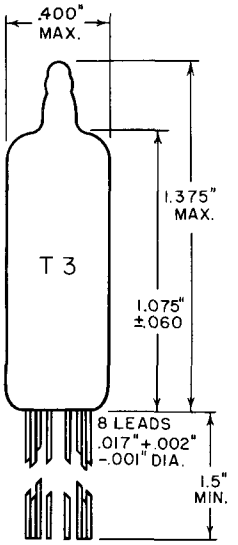
| | |
|---|---|
| Plate Voltage | 100 Vdc |
| Cathode Resistor | 270 Ohms |
| Plate Current | 10.0 mAdc |
| Amplification Factor | 16 |
| Transconductance | 4500 μmhos |
| Grid Voltage for Ib = 100 μAdc Max. | -13.5 Vdc |

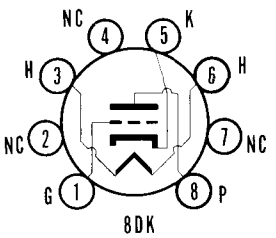
### NOTES:

1. *Limitations beyond which normal tube performance and tube life may be impaired.*
2. *If altitude rating is exceeded, reduction of instantaneous voltages (Ef excluded) may be required.*
3. *Tube life and reliability of performance are directly related to the degree of regulation of the heater voltage to its center rated value of 6.3 volts.*
4. *External shield of 0.405 inch diameter connected to cathode.*
5. *Values shown are as registered with RETMA.*
6. *Per MIL-E-1C Par. 6.5 and General Section of this Sylvania Subminiature Tube Manual titled Specifications and Ratings.*

## QUICK REFERENCE DATA

The Premium Subminiature Type 5977 is a relatively high perveance medium mu triode intended for a variety of applications: power amplifier driver, blocking oscillator, multivibrator and Class C amplifier. It is designed for operation under conditions of severe shock, vibration, high temperature and high altitude. The 5977 is manufactured and inspected to meet the applicable MIL-E-1 specification for reliable operation.




SYLVANIA ELECTRIC PRODUCTS INC.

RADIO TUBE DIVISION
EMPORIUM, PA.

*Prepared and Released By The*
*TECHNICAL PUBLICATIONS SECTION*
*EMPORIUM, PENNSYLVANIA*

FEBRUARY 1957

# ACCEPTANCE CRITERIA

**Test Conditions**

| | | | |
|---|---|---|---|
| Heater Voltage | 6.3 V | Heater-Cathode Voltage MIL-E-1 Par. 3.2.2.1 | 0 V |
| Plate Voltage | 100 Vdc | Cathode Resistor MIL-E-1 Par. 3.2.2.1 | 270 Ohms |
| Grid Voltage | 0 V | | |

For the purposes of inspection, use applicable reliable paragraphs of MIL-E-1 and Inspection Instructions for Electron Tubes.

| MIL-E-1 Ref. | Test | AQL (%) | Limits | | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | Min. | LAL | Bogey | UAL | Max. | |
| **Measurements Acceptance Tests, Part 1, Note 1** | | | | | | | | |
| 4.1.1.7<br>4.10.8 | (Method A)<br>Heater Current: ALD = 12 | — | — | 144 | 150 | 156 | — | mA |
| 4.10.8 | Heater Current: | 0.65 | 140 | — | — | — | 160 | mA |
| 4.10.15 | Heater-Cathode Leakage: | 0.65 | — | — | — | — | — | |
| | Ehk = +100 Vdc | — | — | — | — | — | 5.0 | μAdc |
| | Ehk = −100 Vdc | — | — | — | — | — | 5.0 | μAdc |
| 4.10.6.1 | Grid Current:<br>Rg = 1.0 Meg | 0.65 | 0 | — | — | — | −0.4 | μAdc |
| 4.1.1.7<br>4.10.4.1 | (Method A)<br>Plate Current (1): ALD = 3.4 | — | — | 8.9 | 10.0 | 11.1 | — | mAdc |
| 4.10.4.1 | Plate Current (1): | 0.65 | 7.0 | — | — | — | 13.0 | mAdc |
| 4.10.4.1 | Plate Current (2):<br>Ec = −13.5 Vdc; Rk = 0 Ohms | 0.65 | — | — | — | — | 100 | μAdc |
| 4.1.1.7<br>4.10.9 | (Method A)<br>Transconductance (1): ALD = 900 Sm | — | — | 4200 | 4500 | 4800 | — | μmhos |
| 4.10.9 | Transconductance (1): Sm | 0.65 | 3700 | — | — | — | 5300 | μmhos |
| 4.7.5 | Continuity and Shorts (Inoperatives): | 0.4 | — | — | — | — | — | |
| 4.9.1 | Mechanical:<br>Envelope (8-1) | — | — | — | — | — | — | |
| **Measurements Acceptance Tests, Part 2** | | | | | | | | |
| 4.8.2 | Insulation of Electrodes: | 2.5 | — | — | — | — | — | |
| | g-all | — | 100 | — | — | — | — | Meg |
| | p-all | — | 100 | — | — | — | — | Meg |
| 4.10.9 | Transconductance (2): $\frac{\Delta Sm}{Ef}$<br>Ef = 5.7 V | 2.5 | — | — | — | — | 15 | % |
| 4.10.6.2 | Grid Emission: Note 4<br>Ef = 7.5 V; Ec = −13.5 Vdc; Rg = 1.0 Meg; Rk = 0 Ohms | 2.5 | 0 | — | — | — | −0.5 | μAdc |
| 4.10.3.2 | AF Noise:<br>Esig = 40 mVac; Ec = −4 Vdc; Rg = 0.1 Meg;<br>Rp = 0.01 Meg; Rk = 0 Ohms | 2.5 | — | — | — | — | 17 | VU |
| 4.10.11.1 | Amplification Factor: | 6.5 | 13.5 | — | 16.0 | — | 18.5 | |
| - - - - - | Pulse Emission: Notes 6 and 7<br>Ef = 6.0 V; e pulse = 50 v; tp = 25 μsec;<br>prr = 200 pps | 6.5 | 300 | — | — | — | — | ma |
| 4.10.14 | Capacitance: | 6.5 | — | — | — | — | — | |
| | No Shield Cgp | — | 1.0 | — | — | — | 1.6 | μμf |
| | No Shield Cin | — | 1.5 | — | — | — | 2.5 | μμf |
| | No Shield Cout | — | 0.6 | — | — | — | 1.0 | μμf |
| 4.9.12.1 | Low Pressure Voltage Breakdown:<br>Pressure = 20 ±5 mm Hg.; Voltage = 300 Vac | 6.5 | — | — | — | — | — | |

## ACCEPTANCE CRITERIA (Continued)

| MIL-E-1 Ref. | Test | AQL (%) | Limits | | | | | Units |
|---|---|---|---|---|---|---|---|---|
| | | | Min. | LAL | Bogey | UAL | Max. | |
| **Measurements Acceptance Tests, Part 2 (Continued)** | | | | | | | | |
| 4.9.20.3 | Vibration (1):<br>No Voltages; Post Shock and Fatigue Test End Points Apply | 10.0 | — | — | — | — | — | |
| 4.9.19.1 | Vibration (2):<br>Rp = 10,000 Ohms; Ck = 1000 μf; F = 40 cps; G = 15 | 2.5 | — | — | — | — | 50 | mVac |
| 4.9.19.1 | White Noise: Note 5<br>Rp = 10,000 Ohms; Ck = 1000 μf;<br>Peak Acceleration = 15 G | 2.5<br>2.5 | —<br>— | —<br>— | —<br>— | —<br>— | 200<br>30 | mv pk-pk<br>mVac |
| **Degradation Rate Acceptance Tests, Note 2** | | | | | | | | |
| 4.9.5.3 | Subminiature Lead Fatigue: | 2.5 | — | 4 | — | — | — | arcs |
| 4.9.20.5 | Shock:<br>Hammer Angle = 30°; Ehk = +100 Vdc; Rg = 0.1 Meg | 20 | — | — | — | — | — | |
| 4.9.20.6 | Fatigue:<br>G = 2.5; Fixed Frequency; F = 25 min., 60 max. | 6.5 | — | — | — | — | — | |
| - - - - | Post Shock and Fatigue Test End Points:<br>Vibration (2)<br>Heater-Cathode Leakage<br>Ehk = +100 Vdc<br>Ehk = −100 Vdc<br>Change in Transconductance (1) of<br>Individual Tubes $\Delta_t^{Sm}$ | —<br>—<br>—<br>— | —<br>—<br>—<br>— | —<br>—<br>—<br>— | —<br>—<br>—<br>— | —<br>—<br>—<br>— | 200<br>20<br>20<br>20 | mVac<br>μAdc<br>μAdc<br>% |
| 4.9.6.3 | Glass Strain: | 6.5 | — | — | — | — | — | |

| MIL-E-1 Ref. | Test | AQL (%) | Allowable Defectives per Characteristic | | Limits | | Units |
|---|---|---|---|---|---|---|---|
| | | | 1st Sample | Combined Samples | Min. | Max. | |
| **Acceptance Life Tests, Note 2** | | | | | | | |
| 4.11.7 | Heater Cycling Life Test:<br>Ef = 7.0 V; 1 min. on, 4 min. off;<br>Ehk = 140 Vac; Ec = Eb = O V | 2.5 | — | — | — | — | |
| 4.11.3.1 | Stability Life Test: (1 Hour)<br>Ehk = +200 Vdc; Rg = 1.0 Meg; TA = Room | 1.0 | — | — | — | — | |
| 4.11.4 | Stability Life Test End Points:<br>Change in Transconductance (1) of<br>Individual Tubes $\Delta_t^{Sm}$ | — | — | — | — | 10 | % |
| 4.11.3.1<br>4.11.3.1.1 | Survival Rate Life Test: (100 Hours).<br>Stability Life Test Conditions or<br>Equivalent; TA = Room | — | — | — | — | — | |
| 4.11.4 | Survival Rate Life Test End Points:<br>Continuity and Shorts (Inoperatives)<br>Transconductance (1) Sm | 0.65<br>1.0 | —<br>— | —<br>— | —<br>3300 | —<br>— | <br>μmhos |
| 4.11.5<br>4.11.3.1 | Intermittent Life Test: Note 3<br>*Stability Life Test Conditions;*<br>T Envelope = +220°C min.; 1000 Hour<br>Requirements Do Not Apply | — | — | — | — | — | |

## ACCEPTANCE CRITERIA (Continued)

| MIL-E-1 Ref. | Test | AQL (%) | Allowable Defectives per Characteristic | | Limits | | Units |
|---|---|---|---|---|---|---|---|
| | | | 1st Sample | Combined Samples | Min. | Max. | |
| **Acceptance Life Tests, Note 2 (Continued)** | | | | | | | |
| 4.11.4<br>4.11.3.1 | Intermittent Life Test End Points:<br>(500 Hours) | | | | | | |
| | Inoperatives | — | 1 | 3 | — | — | |
| | Heater Current | — | 2 | 5 | 138 | 164 | mA |
| | Grid Current | — | 1 | 3 | 0 | -1.0 | μAdc |
| | Change in Transconductance (1) of | | | | | | |
| | Individual Tubes $\Delta \frac{Sm}{t}$ | — | 1 | 3 | — | 20 | % |
| | Transconductance (2) $\Delta \frac{Sm}{Ef}$ | — | 2 | 5 | — | 15 | % |
| | Heater-Cathode Leakage | — | 2 | 5 | — | — | |
| | Ehk = +100 Vdc | — | — | — | — | 10 | μAdc |
| | Ehk = —100 Vdc | — | — | — | — | 10 | μAdc |
| | Insulation of Electrodes | — | 2 | 5 | — | — | |
| | g-all | — | — | — | 50 | — | Meg |
| | p-all | — | — | — | 50 | — | Meg |
| | Transconductance (1) Average Change, Avg $\Delta \frac{Sm}{t}$ | — | — | — | — | 15 | % |
| | Total Defectives | — | 4 | 8 | — | — | |

## ACCEPTANCE CRITERIA NOTES:

1: The AQL for the combined defectives for attributes in Measurements Acceptance Tests, Part 1, excluding inoperatives and mechanical shall be one (1) percent. A tube having one (1) or more defects shall be counted as one (1) defective.

2: Tubes subjected to the following destructive tests are not to be accepted under this specification.

| | |
|---|---|
| 4.9.5.3 | Subminiature lead fatigue |
| 4.9.20.5 | Shock |
| 4.9.20.6 | Fatigue |
| 4.11.7 | Heater cycling life test |
| 4.11.5 | Intermittent life test |

3: Envelope temperature is defined as the highest temperature indicated when using a thermocouple of #40 BS or smaller diameter elements welded to a ringe of 0.025 inch diameter phosphor bronze placed in contact with the envelope. Envelope temperature requirement will be satisfied if a tube, having bogey Ib (±5%) under normal test conditions, is determined to operate at maximum specified temperature at any position on the life test rack.

4: Prior to this test tubes shall be preheated five (5) minutes at conditions indicated below. Test within three (3) seconds after preheating. Three-minute test is not permitted. Grid Emission shall be the last test performed on the sample selected for the Grid Emission Test.

| Ef | Ec | Eb | Rk | Rg |
|---|---|---|---|---|
| V | Vdc | Vdc | Ohms | Meg |
| 7.5 | 0 | 100 | 270 | 1.0 |

5: The tube shall be rigidly mounted on a table vibrating such that the instantaneous values of acceleration shall constitute approximately a "White Noise" spectrum which is free from discontinuities from 100 cps to 5000 cps. The spectrum of instantaneous acceleration shall be such that each octave of bandwidth delivers 2.3 G's rms acceleration. With this the case, the rms value of acceleration for any bandwidth within the specified spectrum is equal to

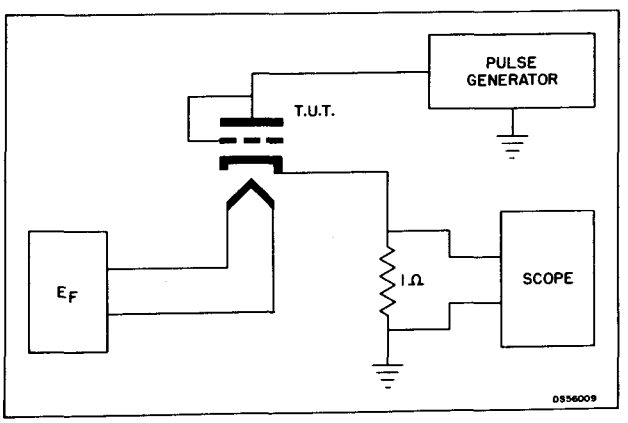
$$G\ rms = 2.3\ G \sqrt{3.32 \log_{10} (f2/f1)}$$

f2 and f1 are the upper and lower frequencies, respectively, of the band under consideration. The degree of clipping of the peak accelerations shall be such that the peak value of acceleration is at at least 15 G's.

The voltage (ep) produced across the resistor (Rp) as a result of vibration shall be coupled through a compensating amplifier to a low pass filter. The compensating amplifier shall have a high input impedance (0.25 megohm or more) and shall be adjusted to compensate for any insertion losses in the filter. The combined frequency response of amplifier and filter shall be flat within ±0.5 db from 50 cps to 8000 cps, shall be down no more than 5 db at 10,000 cps and at 20 cps, and down at least 40 db at 13,000 cps. For reading the peak to peak value of output voltage the filter output shall be fed directly to the input of a Ballantine Model 305 peak to peak electronic voltmeter or equal, while the rms value shall be measured with a Hewlett-Packard Model 400C or equal.

6: Test each section separately.

7: The pulse is essentially a square wave with 1.0 μsec rise time and 0.8 μsec fall. The pulse shall be applied to plate and grid tied together. Pulse emission shall be measured in terms of voltage developed across a 1.0 ohm resistor in the cathode circuit. Test limit as measured by the leading edge of a calibrated oscilloscope trace, the amplitude of the trailing edge of which shall not vary by more than 20 percent from the value of the leading edge.



## APPLICATION DATA

The Premium Subminiature Type 5977 is a medium mu triode having relatively high perveance. It is especially well suited to a wide variety of low frequency applications. These include resistance coupled amplifiers, sync clippers, blocking oscillators and multivibrators. Resistance coupled amplifier data is shown in the accompaning table and circuit. Its ability to handle large signals also lends the tube to power amplifier driver applications.

The 5977 may also be used as a uhf oscillator or Class C amplifier. A curve of power output vs frequency at a constant input of 3.3 watts is shown in Figure 1 for oscillator service. Figure 2 shows the variation of input resistance with frequency.

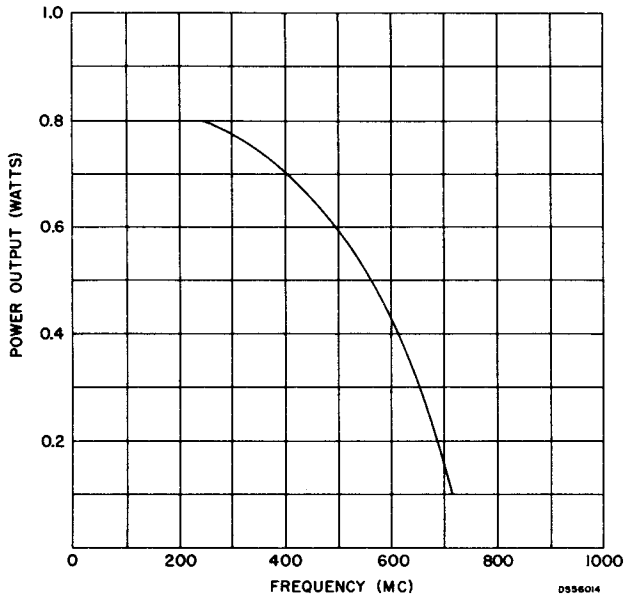



**Figure 1—Oscillator performance curve**

Electrically, the 5977 is similar to the 6AK4. The 5977, however, is manufactured and inspected to meet the applicable MIL-E-1 specification and is intended for operation under severe conditions of vibration, shock, high temperature and high altitude.

To insure correlation with actual field conditions and thereby enhance equipment reliability, vibrational noise output is controlled by the "white noise test" as shown in the acceptance criteria. Briefly, this test consists of subjecting the tubes to a white noise vibration spectrum covering the frequency band of 100 to 5000 cps at a rms level of 2.3 g's per octave and a peak level of 15 g's.

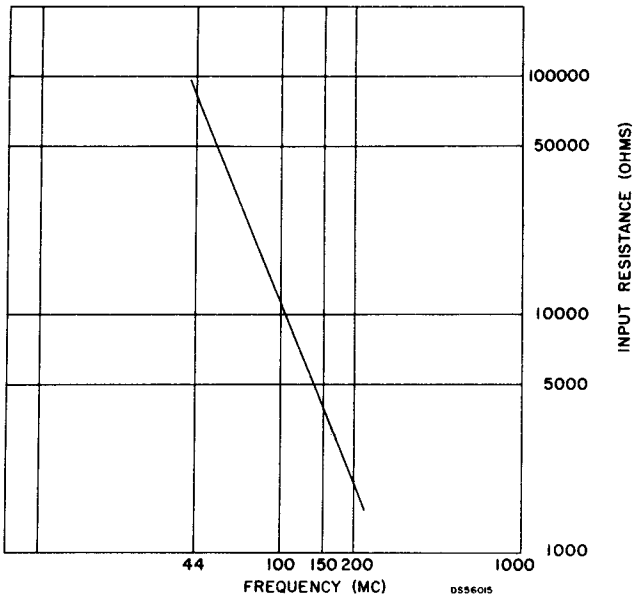



**Figure 2—Input resistance vs frequency**

Limits are shown for both peak and rms output. A further discussion of the white noise vibrational test is included in the frontal section of this manual.

Life expectancy is described by the life tests, specified on the attached pages and/or individual MIL-E-1 specifications. The actual life expectancy of the tubes in an operating circuit is affected by both the operating and environmental conditions involved. Likewise, the life tests specified indicate performance under certain operating criteria to a set of specified end points. Performance at conditions other than those specified can usually be estimated only roughly as giving better or poorer life expectancy. For further discussion of life expectancy, reference should be made to the frontal section of this manual.

To insure optimum performance in pulse applications this type is subjected to a pulse emission test as shown in the accompaning data. The tube must, under the specified pulse operating conditions, deliver a minimum specified current. A further discussion of this test is included in the frontal section of this manual.

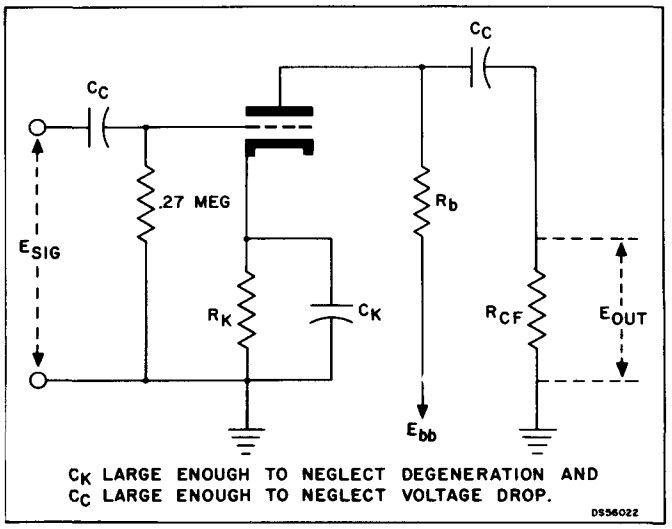
When operated under conditions common to on-off control applications the tube exhibits freedom from the development of interface resistance. The heater-cathode construction is designed to withstand intermittent operation.

*The information presented on this data sheet is furnished without assuming any obligation.*

## RESISTANCE COUPLED AMPLIFIER DATA

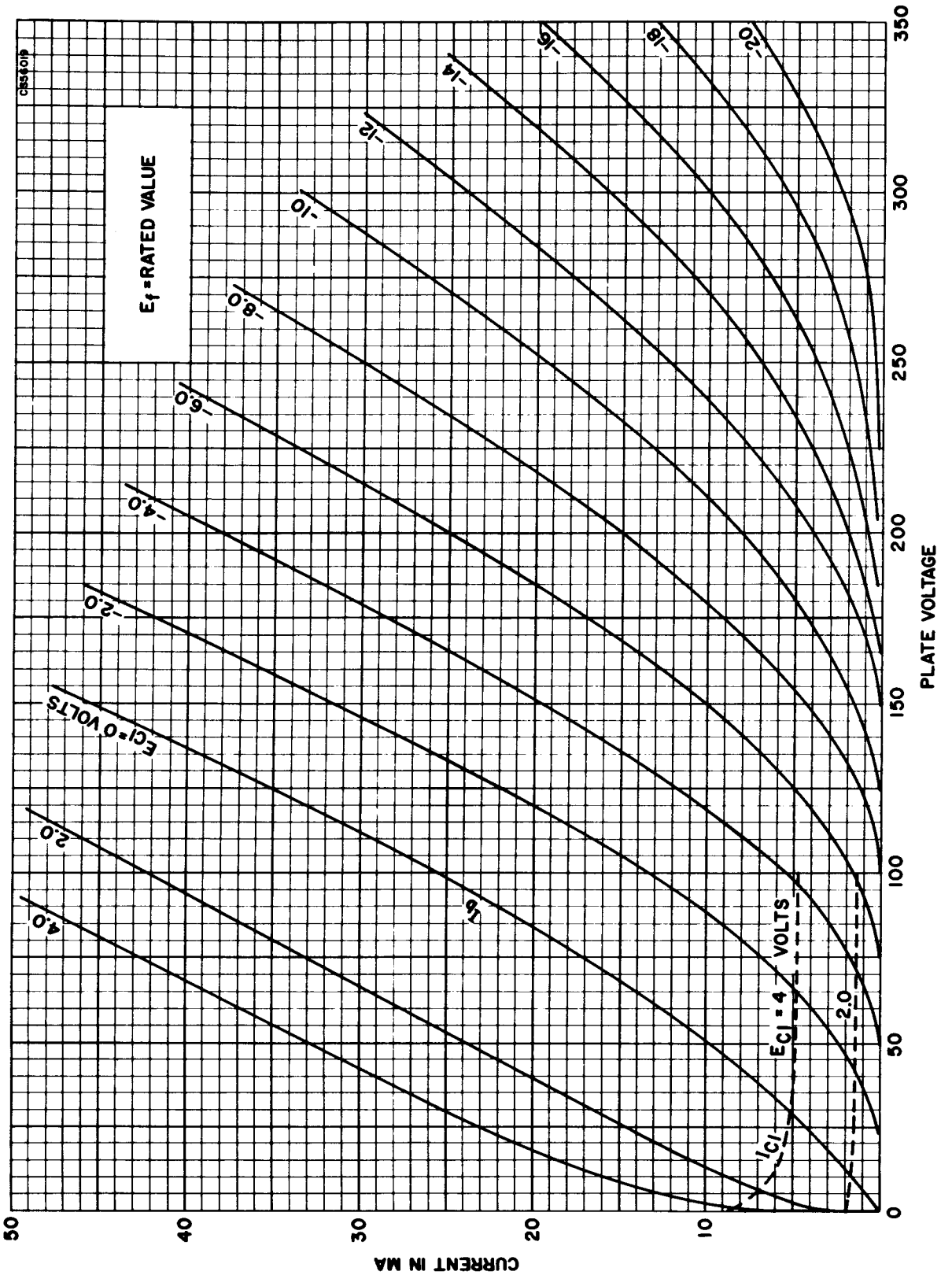
| | Ebb = 100 Volts | | | | | | Ebb = 200 Volts | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rb (megohms) | 0.047 | | 0.10 | | 0.27 | | 0.047 | | 0.10 | | 0.27 | |
| Rcf (megohms) | 0.10 | 0.27 | 0.10 | 0.47 | 0.27 | 0.47 | 0.10 | 0.27 | 0.10 | 0.47 | 0.27 | 0.47 |
| Rk (ohms) | 2200 | 2700 | 3900 | 6800 | 15000 | 18000 | 1500 | 2200 | 3300 | 5600 | 12000 | 15000 |
| Ib (ma) | 1.11 | 1.05 | 0.602 | 0.484 | 0.210 | 0.197 | 2.59 | 2.28 | 1.29 | 1.08 | 0.455 | 0.419 |
| Ec (volts) | −2.44 | −2.84 | −2.35 | −3.29 | −3.15 | −3.55 | −3.88 | −5.02 | −4.26 | −6.05 | −5.46 | −6.29 |
| Eb (volts) | 47.8 | 50.6 | 39.8 | 51.6 | 43.3 | 46.8 | 78.4 | 92.8 | 71.0 | 92.0 | 77.0 | 86.8 |
| Esig (volts, rms) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Eout (volts, rms) | 5.2 | 5.3 | 5.0 | 5.3 | 5.0 | 5.1 | 11.6 | 11.6 | 11.3 | 11.5 | 10.9 | 11.0 |
| Gain | 10.4 | 10.6 | 10.0 | 10.6 | 10.0 | 10.2 | 11.6 | 11.6 | 11.3 | 11.5 | 10.9 | 11.0 |
| % Distortion | 1.8 | 1.4 | 1.8 | 1.1 | 1.3 | 1.0 | 1.8 | 1.4 | 1.7 | 1.0 | 1.3 | 1.0 |
| Esig* (volts, rms) | 1.3 | 1.5 | 1.3 | 1.9 | 1.6 | 1.9 | 2.4 | 3.1 | 2.5 | 3.8 | 3.2 | 3.9 |
| Eout (volts, rms) | 13.6 | 15.9 | 13.0 | 19.9 | 15.4 | 19.3 | 28.0 | 36.2 | 28.0 | 43.3 | 33.5 | 41.5 |
| Gain | 10.4 | 10.6 | 10.0 | 10.5 | 9.6 | 10.2 | 11.6 | 11.7 | 11.2 | 11.4 | 10.5 | 10.6 |
| % Distortion | 5.0 | 4.8 | 5.0 | 4.9 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |

*Maximum signal for 5% distortion or 1/8 microampere grid current.

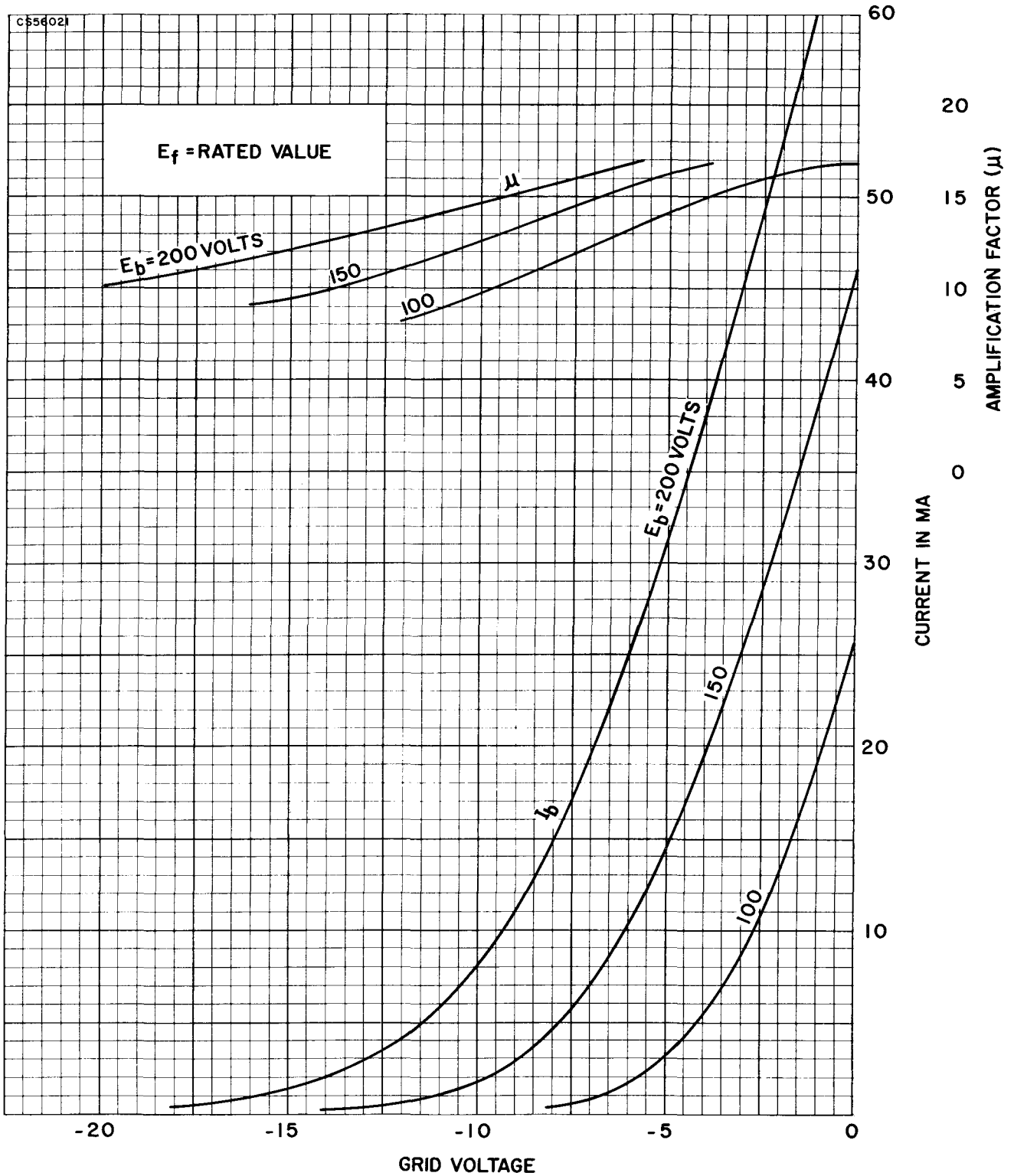



Resistance coupled amplifier circuit

## AVERAGE PLATE CHARACTERISTICS



## AVERAGE TRANSFER CHARACTERISTICS



## AVERAGE TRANSFER CHARACTERISTICS

